

## 24.

A Study of the Yellow-lipped Snake, *Rhadinaea flavilata* (Cope).

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(Plate I; Text-figure 1).

Since the original description of *Rhadinaea flavilata* in 1871 by E. D. Cope, little has been published about this rather uncommon snake. While a few facts have appeared in literature, no complete study of the species has been made. The present author is fully aware that his work is by no means complete; however, this study is a review of previous knowledge, plus further data gained through a careful examination of all available study material, 55 specimens. Since specimens are lacking entirely from many areas, it is impossible to review critically the aspects of distribution, geographical variation and relationships. It is hoped that mention of some of the problems involved will stimulate interest in the gathering of more material.

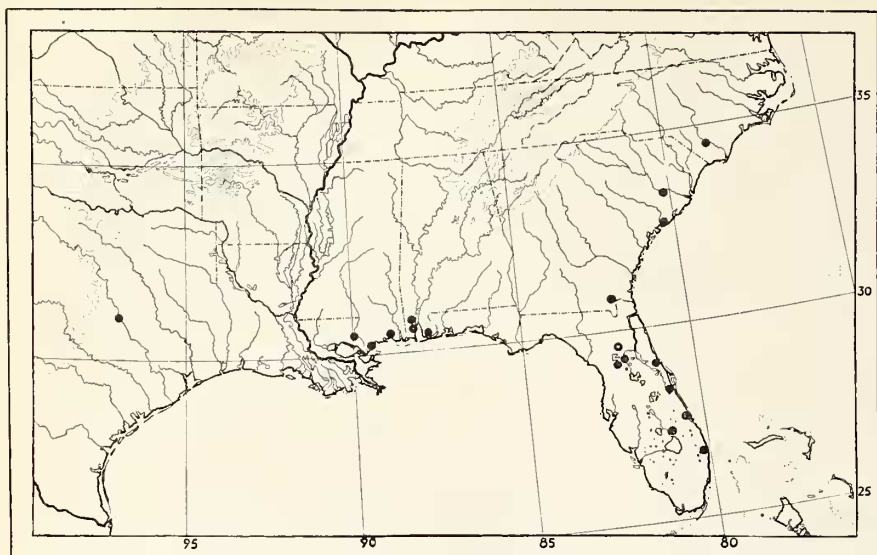
The methods of study followed are those of common practice, with a few deviations. The scale row formula was determined by making scale counts at eight points along the body length, the first one-half inch behind the head, and the last one-quarter inch anterior to the anal. Hemipenial and dental characters were studied in specimens selected from various portions of the range of the species. Comparison with the type could only be made through the original description, for most unfortunately the type specimen (ANSP 5583) has been lost.

Habit and habitat notes were gathered through correspondence with collectors, from notes in literature and from personal field and laboratory observations.<sup>1</sup>

The following abbreviations are used where reference is made to definite museum specimens:

AMNH	American Museum of Natural History
ANSP	Academy of Natural Sciences of Philadelphia
ASM	Alabama State Museum
ChM	Charleston Museum
CFK	Carl F. Kauffeld Collection
CM	Carnegie Museum
CU	Cornell University Museum
FMNH	Field Museum of Natural History
FNB	Frank N. Blanchard Collection
UMMZ	University of Michigan Museum of Zoology
USNM	United States National Museum
ZSP	Zoological Society of Philadelphia

<sup>1</sup> The author wishes to thank the following persons, (responsible for the herpetological collections in their respective museums), for the loan of the necessary material to make this study: Doris M. Cochran, United States National Museum; Mrs. Helen T. Gaige, Museum of Zoology, University of Michigan; Charles M. Bogert, American Museum of Natural History; Dr. E. R. Dunn, Academy of Natural Sciences of Philadelphia; D. L. De Jarnette, Alabama State Museum; M. Graham



Text-figure 1.

Distribution of *Rhadinaea flavilata*. Solid circles indicate localities from which specimens have been examined; hollow circles, localities in literature from which specimens are not available.

## SYNONYMY.

*Rhadinaea flavilata* (Cope)*Dromicus flavilatus*:

Cope 1871, *Proc. Acad. Nat. Sci. Phila.*, Vol. XXIII, pp. 222-223; 1875, *Bull. U. S. N. M.*, No. 1, p. 38; 1892, *Proc. U. S. N. M.*, Vol. XIV, No. 882, p. 618.

*Rhadinaea flavilata*:

Cope 1894, *Proc. Acad. Nat. Sci. Phila.*, Vol. XLVI, p. 428; 1895, *Trans. Amer. Philos. Soc.*, Vol. XVIII, p. 202; 1900, *Rep't United States Nat. Mus.*, p. 759; Brown 1901, *Proc. Acad. Nat. Sci. Phila.*, Vol. LII, p. 88; Dunn 1932, *Occ. Pap. Mus. Zool., Univ. Mich.*, No. 251, pp. 1-2; Stejneger & Barbour 1933, Check-list No. Amer. Amphib. Rept., Ed. 3, p. 105; Netting 1936, *Copeia*, No. 2, p. 114; Stejneger & Barbour 1939, Check-list No. Amer. Amphib. Rept., Ed. 4, p. 100; Campbell & Stickel 1939, *Copeia*, No. 2, p. 105.

*Liophis flavilatus*:

Boulenger 1894, *Cat. Snakes Brit. Mus. (Nat. Hist.)*, Vol. II, p. 143.

Netting, Carnegie Museum; Karl P. Schmidt, Field Museum of Natural History; Harold Trapido, Cornell University Museum. Especial thanks are due Dr. Howard K. Gloyd for his kindness in permitting the study of specimens from the collection of the late Dr. Frank N. Blanchard. Carl F. Kaufeld allowed me the use of material from his private collection.

To the herpetologists who have collected this snake in the field, the author wishes to extend his thanks for their generosity in turning over their field notes for his use. Dr. Leonhard Stejneger and Joseph R. Bailey, for aid in defining certain data, and J. Laird Starr of Philadelphia, for help in the accumulation of data, earn the appreciation of the author. Mark Mooney, Jr., Zoological Society of Philadelphia, was kind enough to supply the photograph.

Roger Conant has been both guide and critic. His suggestions and views on critical points have been invaluable. For these I offer my sincere gratitude.

*Leimadophis flavilatus*:

Stejneger & Barbour 1917, Check-list No. Amer. Amphib. Rept., Ed. 1, p. 86; 1923, *Ibid.* Ed. 2, p. 96; Blanchard 1924, *Pap. Mich. Acad. Arts, Sci. and Lett.*, Vol. IV, Pt. II, p. 41.

*Rhadinaea flavilata* was originally described by Cope in 1871 on the basis of a single specimen collected by Dr. Yarrow (1878, p. 27) "on the Boque banks, some eight miles south of Ft. Macon (Beaufort, North Carolina), near marshy ground." Placing the species in the genus *Dromicus* in 1871, Cope later (1894) referred it to *Rhadinaea*, basing his change on the hemipenial characteristics. The same year, 1894, Boulenger allocated *flavilata* to *Liophis*. Boulenger had never seen a specimen of *flavilata* and evidently his procedure was founded on descriptions in literature. It is interesting to note that in 1898, two specimens from Bay St. Louis, Mississippi, reached the British Museum, and it is indicated from notes on the bottle and in his catalogue that Boulenger immediately recognized his error in referring *flavilata* to *Liophis*. (Malcolm Smith, in corres. March 10, 1939.)

In 1917, Stejneger & Barbour (p. 86) placed *flavilata* in the genus *Leimadophis*. Boulenger (*l.c.*) had placed the species in *Liophis*, congeneric with *almadensis*. Stejneger regarded *almadensis* and *flavilata* as probably congeneric, but disagreed with Boulenger in placing the two forms in *Liophis*, and consequently put both in *Leimadophis*, type *almadensis*. The species remained in this genus until 1932, when Dunn (pp. 1-2) referred it once again to *Rhadinaea*, considering the form as congeneric with *vermiculaticeps* (type *Rhadinaea* Cope, by original designation).

DESCRIPTION: Habit slender; head 1.50 to 2.25 times as long as wide, slightly wider than the neck. Tail 27.7 to 37.7% of the total length. Scales smooth, without apical pits, in 17 rows—occasionally 18 or 19 rows immediately behind the head. Ventrals 123-141; anal plate divided; subcaudals 60-83. Supralabials 7, rarely 8; third and fourth entering the orbit, sixth the largest. Infralabials 9, occasionally 8, rarely 7 or 10; first five bounding the genials, fourth and fifth the largest. Postgenials slightly longer than pregenials. One preocular; two postoculars, the lower very small. Occasional individuals may have a small extra postocular plate lying between the lower postocular and the fifth supralabial (one specimen each from Florida, Alabama and Mississippi). Loreal small, as high as long. Two nasals, the nostril entirely within the prenasal. Rostral much wider than high, scarcely visible from above. Internasals nearly quadrate; prefrontals wider than long. Frontal long, narrow; parietals elongate, truncate posteriorly.

The hemipenis is single, extends to the ninth subcaudal; sulcus spermaticus forked opposite the sixth subcaudal. Calyculate apically, calyces slightly papillose, capitate. Spinous distally, spines arranged in 5 to 7 longitudinal rows, the two median rows enlarged, forming a central cluster of enlarged spines. Basal portion of organ smooth.

Maxillary teeth 13, the last two slightly enlarged and separated from the others by a short interspace. Mandibular teeth 13 to 17, subequal; palatine teeth 9.

Dorsal color rich amber brown (color nomenclature from Ridgway) fading to light orange-yellow or orange-buff on the fourth to the second scale rows and edges of the ventral plates. (Some individuals may have the first three scale rows finely stippled with amber brown.) The scales of the median row are tipped at their posterior edge with auburn, producing a broken, but distinct median stripe, which, however, may be faint or even lacking in some specimens. Not infrequently specimens show a broken lateral stripe on the third scale row, more prominent on the anterior quarter of the body, and which is formed in the same manner as the median stripe. Ventral surface pale martius or marguerite yellow, fading to whitish on

the chin and throat. Top of head auburn, irregularly marked with minute, paler vermiculations. Labials light maize yellow or sulphur yellow. A chestnut line extending from the tip of the snout through the orbit, along the upper edge of the supralabials to the angle of the jaw, finely edged with black above; less distinct anterior to the eye. Rostral and the first two supralabials light hazel; infralabials and mental sparsely spotted with auburn. Occasional individuals show light, black-edged spots on the common parietal suture; others may have very indistinct light patches on each side of the neck.

Average adult length, 299 mm.; largest female, 377 mm., largest male, 340 mm.

VARIATIONS: Sexual dimorphism in *flavilata* is not great. The range of ventrals in the males is from 123 to 135, averaging 128.5, and in the females from 128 to 141, averaging 133.6. The number of subcaudals in males varies from 69 to 83, averaging 75.5, while the range in the females is from 60 to 70, the average being 66.3.

Of the total number of specimens examined, 35% have a portion of the tail missing. With a series of nineteen males and seventeen females used in determining the tail ratio in each sex, these figures were obtained: males, .287 to .337, average .321; females, .277 to .314, average .301.

Blanchard (1931, p. 35) calls attention to the fact that the males of certain smooth-scaled snakes possess keel-like ridges on the scales of the anal region. Among the species observed by him as possessing this character is *Leimadophis flavilatus* (= *Rhadinaea flavilata*). Blanchard further states that he believes that these anal ridges are not homologous with the true keel. A microscopic study of the anal ridges found on the males of the species under discussion proves this to be the case.

As seen with the naked eye, the scales of the anal region of male *flavilata* bear distinct ridges, extending from the base of the scale approximately one-quarter to three-quarters of the distance to the apex. When examined under the microscope, an entirely different aspect is obtained. No keel is apparent and the cellular construction of the scale is the same as that found in true smooth scales. Of what importance this character may prove to be, is at present unknown. Further study is planned and it is hoped that some interpretation can be made in the future.

Male *flavilata* examined of a length greater than 236 mm. possess anal ridges, and those of 300 mm. and over exhibit the character to a marked degree (two specimens, of 275 mm. and 305 mm. respectively, lack the ridges). The largest specimen not showing anal ridges, is one of 206 mm. Specimens between this size (206 mm.) and 236 mm. are not at present available for study. If these ridges be considered correlated with the attainment of sexual maturity in male *flavilata*, it is suggested that maturity is probably reached at about 215 mm., but a larger series of males is to be desired before definite conclusions can be set down. Anal ridges are not present on any of the females examined.

Geographical variation within the species is slight. The number of ventrals has been found to be higher in the East (North and South Carolina, Georgia and Florida) where ventral counts range from 126 to 141 (males, 126 to 135; females 128 to 141), averaging 132 (av. male, 130; av. female, 134). In the western portion of the range (Alabama, Mississippi, Louisiana and Texas) the ventral count varies from 123 to 135 (males, 123 to 132; females, 131 to 135), averaging 130 (av. male, 129; av. female, 133). Subcaudal counts tend to be higher to the west. In the East these counts range from 60 to 79 (males, 69 to 79; females, 60 to 69), averaging 69 (av. male, 74; av. female, 67), while the western counts of subcaudals show the variation to be from 63 to 83 (males, 70 to 83; females, 63 to 70) with an average of 70 (av. male, 74; av. female, 66).

Labial characters are rather constant throughout the range. Of the material examined from Florida, 35% has a reduction of the infralabial count to eight, but only on one side of the head. One specimen has the formula 7-8. An individual from Mississippi shows an increase of infralabials to 10-10. There is but one deviation from the normal supralabial count of 7-7; an Alabama specimen possessing the count of 8-8.

Color variation in *flavilata* is individual, but with an apparent correlation with geographic range. This variation is restricted to the more or less distinctiveness of the dark dorsal striping. In general, eastern specimens are uniform in color, the striping being noted only by the occasional appearance of the median stripe. In the west, the median stripe becomes more prominent, and the lateral stripes make their appearance.

**HABITS AND HABITAT:**<sup>2</sup> *Rhadinaea flavilata* is decidedly a lowland form. Locality records show it to be confined to a narrow coastal strip, and no specimen has been collected at an altitude in excess of 120 feet, with the single exception of the one Texas specimen, collected at 620 feet.

Known altitude records for the localities at which this species has been collected are as follows: NORTH CAROLINA: Councils, 70 feet; SOUTH CAROLINA: Alvin, 50 feet; 15 m. NE Mt. Pleasant, 30 feet; GEORGIA: Chesser's Island, Okefinokee Swamp, 120 feet; FLORIDA: near Opal, 40 feet; Sebastian, 19 feet; 10 m. Silver Springs, 47-65 feet; ALABAMA: 10 m. S. Foley, 2 feet; Mobile, 8-75 feet; MISSISSIPPI: Biloxi, 19-23 feet; Bay St. Louis, 21-28 feet; LOUISIANA: Sun, 11-50 feet; TEXAS: Clifton, 620 feet.

The Yellow-lipped Snake is secretive in its habits, rarely appearing on the surface of the ground. Haltom (1931, p. 48) writes that it "burrows in soft soil, leaves and decaying logs," and Van Hynning (1933, p. 6) has found it "under bark or logs." Löding (1922, p. 33) reports the species as being "not uncommon in low, cut-over pine lands under logs in early spring," and Allen (1932, p. 14) has taken it "beneath the bark of stumps . . . under pile of straw in company with *O. ventralis*."

The present author collected three specimens in South Carolina on the edge of the Santee Swamp (Alvin, 7 m. E of St. Stephens), in May, 1938. One was discovered under dead leaves at the base of a fence running through rather open pine woods. The others, taken at the same spot, the edge of a large area that is flooded with each rain, were found approximately two inches under the surface of loose, damp, sandy soil. In this, and in similar habitats in the same region, *Hyla squirella*, *Leiopisma unicolor*, *Diadophis p. punctatus* and *Storeria occipito-maculata* are common.

Stewart Springer collected *flavilata* near Biloxi, Mississippi, under similar conditions. The Biloxi locality, along the Tohoulacaboeffa River, is a pine-woods flat with occasional gum- and cypress-surrounded ponds, and the entire area is flooded once in two years. The species is common under logs along with *Virginia* (= *Haldea*), and *Rana hecksheri* is the most abundant frog in the area.

In Florida, the conditions preferred by *flavilata* are somewhat modified. This species in Florida is one of the open dry flatwoods, though always in close proximity to water. Carl F. Kauffeld has taken the snake under fallen tree stumps on a palmetto prairie with a sprinkling of pines, near Lake Okeechobee. *Ophisaurus* and *Diadophis* were taken close by. Campbell & Stickel (1939, p. 105) write of *flavilata* being found in quartz sand country

<sup>2</sup> Recently, E. Ross Allen (*Copeia*, 1939, No. 3, p. 175) has presented some additional notes concerning this species. Three eggs were laid by a female in his possession, August 19, 1937, measuring 23 x 8 mm. These eggs hatched in September, 1937, the young snakes averaging 167 mm. in length, the tail 41 mm. Individuals taken by Allen have been found under logs and bark in open flat woods of pine and oak. In captivity they have eaten *Bufo quercicus* and *Acris gryllus*. The largest specimen in a series of 60 Florida adults is one of 402 mm. (sex?). Additional localities noted by him are Sarasota and Glades counties.

in Florida, as well as in the peat regions, but when found in such a locality, it is in as damp a spot as possible.

Food notes in literature are practically non-existent. Haltom (*l.c.*) says that *flavilata* feeds "on small insects," a statement that appears doubtful in view of the findings noted below. Campbell & Stickei (*l.c.*) fed a captive specimen for a time on *Microhyla carolinensis*. Examination of the stomach remains of specimens studied by the author yielded unidentifiable remains of small frogs (*Hyla?*) and the tail of a *Leiopisma unicolor*. In the laboratory of the writer various animals were offered as food to captive specimens, including small insects, earthworms, salamanders, small frogs (yg. *Rana catesbeiana* and *Hyla crucifer*), small lizards (*Anolis carolinensis*), and baby mice. Of the above, *A. carolinensis*, a small individual of *Rana catesbeiana* and one of *Hyla crucifer* were taken. Unfortunately, only the eating of the *Anolis* was witnessed.

On the introduction of the *Anolis* into the cage containing a single specimen of *flavilata*, the lizard scurried about the cage, the *flavilata* remaining hidden under the water pan. As the anole rested momentarily by the water dish, the snake suddenly projected its head from the hiding place, immediately seizing the lizard with its jaws at mid-body. No attempt was made to constrict, the snake simply retaining its hold, chewing occasionally, until the anole had ceased its struggling. At cessation of struggle by the lizard the snake worked its jaws along the lizard's body to the head, where it at once began swallowing operations. During the entire time, from when the snake first bit the lizard, until it had completely swallowed it, the snake never projected more than an inch or two of its head and body from its place of concealment.

The anole was, tail inclusive, approximately the same length as the snake, though the snake was at no time in discomfort. The process of eating, from the first bite to the complete disappearance of the lizard into the mouth of the snake, took about twenty-five minutes.

Though not uncommon where found, *flavilata* seems restricted to a definite ecological niche, and very rarely is it found in extra-limital habitats. The communities in which it lives are essentially hygrocolum. *Rhadinaea*, and the forms with which it is intimately associated, *Hyla*, *Microhyla*, *Rana*, *Anolis*, *Leiopisma*, *Ophisaurus*, *Virginia*, *Diadophis*, *Lampropeltis* and *Storeria* inhabit damp-ground areas. The soil, regardless of composition, may be damp, usually is loose. Secretive, as are most of its associates, *flavilata* is rarely found in the open, showing preference for hiding or burrowing in the sub-soil, in rotten logs, under loose bark (either on living trees or on rotting trunks), or under the ground carpet of fallen leaves. The presence of *flavilata* in this type of community and the food habits as far as known, are in close correlation. The examination of stomach contents and laboratory experiments have shown that this species feeds on small frogs, ground-living lizards, and, in all probability, on smaller individuals of other secretive species of snakes (i.e. *Storeria*, *Diadophis*). It is hypothesized that *flavilata* arrived in these communities after their establishment with enough force to become a sub-dominant influence in the association, being itself dominated by such forms as *Ophisaurus* and *Lampropeltis*. The time of its arrival and the method are unknown, and the only datum that may be construed as evidence of an exotic origin is the foreign position of its inter-generic allies.

**RANGE:** A narrow coastal strip from Carteret County, North Carolina, south through peninsular Florida to Palm Beach County; west along the Gulf Coast to Tammany County, Louisiana; Bosque County, Texas.

Specimens have been examined from the following localities: NORTH CAROLINA: Councils, Bladen County (CU 6740); SOUTH CAROLINA: Alvin, Berkeley County (ChM 39.4.1.-2; ZSP 1068); 15 m. NE Mt. Pleasant,

Charleston County (FMNH 4076); GEORGIA: Chesser's Island, Okeefinokee Swamp, Charlton County (FNB); FLORIDA: Georgiana, Brevard County (USNM 11989, 13642, 13649, 13661, 13708); Sebastian, Indian County (UMMZ 56987); near Silver Springs, Marion County (CM 9636-46; CU 2211); Florida Route 29, N of Okeechobee, near Opal, Okeechobee County (CFK 329-30; AMNH 50491); Lake Worth, Palm Beach County (UMMZ 85110); Volusia, Volusia County (ANSP 10800); Warren County (ANSP 11730); ALABAMA: Alabama (ASM); 10 m. S Foley, Baldwin County (CM 9879); Mobile, Mobile County (FNB; CU 1739; USNM 51888, 56445-46); MISSISSIPPI: Bay St. Louis, Hancock County (ANSP 12061-62; USNM 24452-54, 56443-44); near Biloxi, Harrison County (CM 5240; CU 1867; FMNH 12000, 21533; UMMZ 76827); LOUISIANA: Sun, Tammany County (FNB); TEXAS: near Clifton, Bosque County (CM 8937).

Locality records in literature from which specimens were not examined, are as follows: NORTH CAROLINA: Fort Macon (Beaufort), Carteret County (Cope, 1871); FLORIDA: Gainsville, Alachua County (Van Hynning, 1933).

AFFINITIES: The well-differentiated characters and the isolated range of *flavilata* preclude the possibility of close affinity to any of the other forms of *Rhadinaea*. The appearance of striping on western specimens may be indicative of relationship to Central American *Rhadinaea*, possibly through *laureata* of the Mexican Plateau.

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### EXPLANATION OF THE PLATE.

#### PLATE I.

*Rhadinaea flavilata* collected at Alvin, Berkeley County, South Carolina, by the author, May, 1938. The dark stippling of the lateral scale rows is rather distinct in this specimen. Photograph by Mark Mooney, Jr., Zoological Society of Philadelphia.